The effect of supplementation on milk yield in Boer goat ewes

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The effect of supplementation on the milk production of Boer goat ewes maintained under veld conditions (grass-/bush community) was studied over a 12-week lactation period. An average of 625 g concentrates was consumed per ewe per day. Supplemented ewes produced on average 11,5% (= 0,235 l/day) more milk than the control group during the 12-week period ($P < 0,01$). The milk composition over the 12-week period was not significantly ($P > 0,05$) affected by supplementation. The supplemented group lost 4,38 kg in body mass per ewe compared to 9,93 kg for the control group. Period of occupation per camp, irrespective of whether they received supplementation or not, seems to be a major factor affecting milk production of goat ewes on natural veld.

'n Ondersoek na die invloed van byvoeding op die melkproduksie van weidende Boerbokooie in 'n gras-/bosgemeenskap is oor 'n 12-week-laktasieperiode onderneem. Die ooie het gemiddeld 625 g kragvoer per dag ingeneem. Ooie wat byvoeding ontvang het, het gemiddeld 11,5% (= 0,235 l/dag) meer melk geproduseer as die kontrolegroep gedurende die 12-week-periode ($P < 0,01$). Die gemiddelde melksamestelling oor die 12-week-periode is nie betekenisvol ($P > 0,05$) beïnvloed deur byvoeding nie. Die byvoedingsgroep het 4,38 kg liggaamsmassa verloor teenoor die 9,93 kg van die kontrolegroep. Die beweidingsperiode per kamp, ongeag byvoeding, blyk een van die hooffaktore te wees wat melkproduksie van die bokooi op natuurlike veld beïnvloed.

Keywords: Goats, supplementation, milk production

Introduction

Although the milk yield of Boer goats increases with an increase in litter size (Ueckermann, 1969; Raats, Wilke & Du Toit, 1983; Fourie & Venter, 1985), the total amount of milk available to individual twins and triplets is not more than 65% and 51% respectively of that available to single kids (Raats, *et al.*, 1983). In the present study, the degree to which parity in milk intake could be accomplished through supplementation of the ewe was investigated.

Procedure

A group of 81 mature (3 – 4 years) Boer goat ewes was synchronized at mating. Kidding commenced in late September, lasting 8 days, during which time 31 twin-bearing ewes were randomly selected and divided into two groups based on equal milk production 3 days post partum. Ewes which subsequently lost a kid or developed mastitis were excluded from the experimental groups. Live mass of ewes was determined on a weekly basis commencing 7 days post partum. Three paddocks, which had been rested for one year, with a total area of 26,2 ha were used as grazing for the experimental animals during the first 12 weeks of lactation. The browsing capacity of each paddock (Figure 1) was calculated according to the method described by Teague, Trollope & Aucamp (1981). The browsing periods and the size of each paddock are indicated in Figure 1. Stocking rate and period of occupation per camp were based on the aforementioned browsing capacity. The paddocks consisted of veld classified as False Thornveld of the Eastern Province (Region 21; Acocks 1975). The dominant grass species were *Sporobolus fimbriatus* (26%) and *Digitaria eriantha* (25%). The dominant bush species acceptable to goats (Trollope, 1981) were *Acacia karroo* (274/ha), *Ehretia rigida* (167/ha), *Rhus lucida* (160/ha), *Xeromphis rudis* (141/ha), and *Grewia occidentalis* (122/ha).

Supplementation commenced 5 days post partum. The experimental animals were placed in a holding pen overnight during which time one group received 760 g supplement per ewe on an individual basis. The supplement consisted of 560 g yellow maize meal and 200 g commercial pre-mix (51% crude protein, 17% urea) with a calculated chemical composition of 10,8 MJ ME/kg, 19,8% crude protein, 0,6% calcium, 0,7% phosphorus, and 88% dry matter. The amount of supplement made available per ewe is equivalent to the amounts of both energy and crude protein required to produce one litre of milk with an energy content of 5,128 MJ (McDonald, Edwards & Greenhalgh, 1973; van der Merwe, 1977). This supplementation was calculated to be sufficient to increase the milk yield in order to provide individual twin kids with 80% of the milk available to singles (Raats, *et al.*, 1983).

Milk production was measured at weekly intervals using a method similar to that of McCance (1959), whereby an intravenous injection of 5 i.u. synthetic oxytocin was followed by hand milking. Three hours later the same procedure was followed. From this second milking, the yield was estimated and milk samples were obtained. Milk samples were analysed on a weekly basis for protein, fat, total solids and lactose. Protein content was determined by the Macro-Kjeldahl technique (IDF, 1962). Fat content was determined by the Gerber method, using a 10,77 ml pipette on diluted milk samples. Lactose content was determined by the chloramine-T method (IDF, 1974) and total solids

content according to the procedure described by the AOAC (1975).

Data were analysed using a least square analysis of variance with unequal subclass numbers according to the method of Harvey (1960). Lactose content of the milk was determined on a group basis and it was therefore excluded from the statistical analysis.

Results

The effect of supplementation on live mass, milk yield, and milk composition during the first 12 weeks of lactation is given in Table 1.

Table 1 The influence of supplementation on the milk yield of Boer goat ewes over a period of 12 weeks

	Treatment	
	Supplementation	Control
n	16	15
Supplement intake (kg/ewe)	49,39	—
Initial live mass (kg/ewe)	54,60±1,4*[a]	61,65±2,0[b]
Live mass change (kg/ewe)	–4,38±0,75[a]	–9,93±0,89[b]
Initial milk production (l/ewe/day)	2,206±0,06	2,199±0,06
Milk production (l/ewe/day)	2,282±0,05[a]	2,047±0,05[b]
Milk protein (%)	4,10±0,07	4,13±0,06
Milk fat (%)	6,37±0,15	6,39±0,21
Total solids (%)	15,91±0,16	15,90±0,26
Lactose (%)	4,85	4,80

* Standard error of the mean

[a,b] Means with different superscripts differ significantly at the 1% level

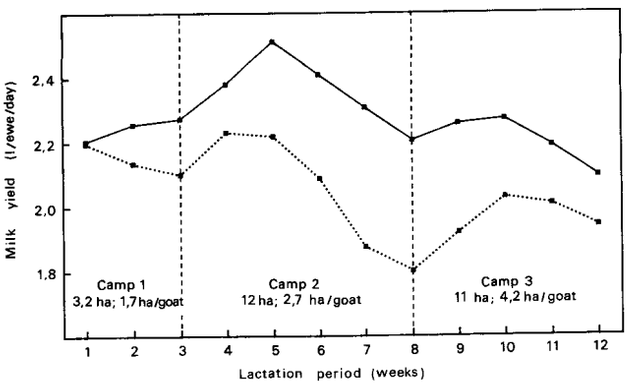

Figure 1 Average daily milk yield of supplemented (—) and non-supplemented (····) Boer goat ewes

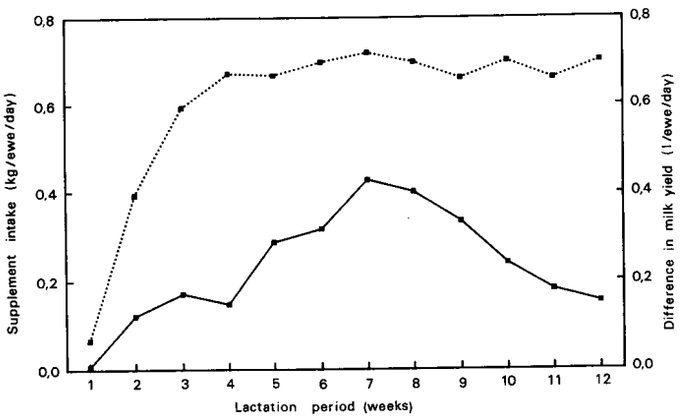

Figure 2 Average daily intake of supplement (····) and the difference in average daily milk yield (—) between the supplemented and control groups

Supplementation had a significant ($P < 0,01$) effect on both milk yield and live mass change during the first 12 weeks of lactation (Table 1). However, the average composition of the milk during the same period was not significantly ($P > 0,05$) influenced by supplementation.

Ewes from the supplement group consumed on average 49,39 kg (625 g/day) of concentrate, which represents 82,3% of the total amount of supplement made available per ewe during the first 12 weeks of lactation. The average daily consumption of supplement, (Figure 2) increased sharply from 67 g during the first week to 674 g per day during the 4th week, after which it remained relatively constant until the end of the 12-week period. A maximum intake of 721 g per ewe per day occurred during the 7th week of lactation.

Supplemented ewes produced on average 11,5% (= 0,235 l/day) more milk than the control group during the 12-week lactation period. This effect is also evident from the average lactation curves and from the difference in milk yield between groups as illustrated in Figures 1 and 2 respectively. The advantage gained in milk production by supplementation over the control group increased steadily (except during the 4th week) to reach a maximum of 0,432 l per ewe per day during the 8th week of lactation, an average increase of 11,4% (Figure 2). Subsequent to this peak, the effect of supplementation decreased at a constant rate until the end of the recorded period when the difference in average daily milk yield between groups was only 0,154 l per ewe. A relationship is apparent between the initial period of occupation in each camp and average milk yield, irrespective of supplementation (Figure 1). The average milk yield of both groups increased during the first 2 weeks of browsing (36 browsing days/ha) in camps 2 and 3, followed by a sharp decrease until the end of each browsing period. During early lactation the equivalent of 36 browsing days per ha in camp 1 was reached after only 3 days. Due to the relatively long interval (7 days) between milk production determinations the above-mentioned effect was not visible during the first 3 weeks of lactation in Figure 1. It is however obvious that the average milk yield of both groups was substantially lower than the expected yield during early lactation when compared to a normal lactation curve.

Maxinum yield in both groups was reached during the 5th week of lactation. The average milk composition over the total period of 12 weeks was not significantly ($P > 0,05$) affected by supplementation as Table 1 shows.

Both the supplemented and control groups experienced a loss in body mass during the 12-week lactation period. The mean live mass loss for these two

groups was 4,38 kg and 9,93 kg, respectively. The percentage reduction in live mass during the first 5 weeks of lactation was 15,3 and 20,3 respectively, for the above-mentioned groups. A turning point in live mass change was reached in both groups during the 5th week of lactation. From this point onwards, the supplemented and control groups regained on average 48% and 21% respectively of the initial live mass loss.

Discussion

The significant increase in milk production that resulted from concentrate feeding supports the general conclusion that milk production in goats is affected by level of nutrition (Sachdeva, Sengar, Singh & Lindahl, 1974; Morand-Fehr & Sauvant, 1978; Morand-Fehr, 1981; El-Serafy, Refaat, Khattab, El-Ashry, Soliman, Kotby & El-Badawy, 1982; and Mittal, 1985). The response to supplementation in this study is, however, smaller than that obtained with milk goats. Sauvant & Morand-Fehr (1977) and Sauvant & Morand-Fehr (unpublished) as quoted by Morand-Fehr (1981) found that milk goats fed concentrates in addition to the basal diet of lucerne hay produced 79 g and 140 g additional milk per 100 g of concentrate, respectively. The corresponding figure in this study was only an additional 37 ml mllk per 100 g supplement. Morand-Fehr (1981) concluded that the response of milk yield to the supply of concentrates depends on the mode of concentrate feeding, i.e. whether given according to the milk production level or not. Concentrates fed according to level of milk production resulted in an increase in milk yield of 480 g per 100 g concentrate fed (Sauvant & Morand-Fehr, 1977 cited by Morand-Fehr, 1981).

The relatively small response to supplementation in this study may in part be due to the following factors. Firstly, the significantly heavier ewes in the control group may have possessed larger body reserves, though no apparent differences in condition were observed between groups. Gall (1981) concluded that there is a positive relationship between milk yield and live mass in goats, but that variation in live mass accounts for only 10% of the variation in milk yield. Secondly, a large proportion of the supplemented nutrients could have been used to substitute or replace body reserves, especially during the latter part of the 12-week period which is evident from the significant difference in live mass change between the two groups. Thirdly, the effect of supplementation was delayed until approximately 4 weeks post partum when near maximum intakes were obtained. Furthermore, it is not known to what extent concentrates substituted natural browsing and hence total energy intake of ewes.

The results indicate that one of the main factors that affected milk yield in this study was the period of occupation per camp, irrespective of level of supplementation. To the author's knowledge no such influence has been reported previously. Although the stocking rate and period of occupation per camp was based on the calculated browsing capacity of the veld, milk yield was sustained for a very short period only (36 browsing days/ha) in both paddocks 2 and 3. This phenomenon occurred in spite of the substantial difference in a browsing capacity between the aforementioned camps. A possible explanation for this is given by Teague (1987). Studies on *Acacia karroo* in the same area and time of the present investigation, show that at the time of occupation of camp 2, the standing crop of this species was approximately 25% of the peak seasonal production. By the time camp 3 was utilized, the bush had approximately 5 weeks of additional active growth which could have provided 50% of the peak seasonal production (Teague, personal communication). This may in part explain why the milk production pattern in two different paddocks appeared to be the same.

The growing difference in milk production between groups during the first 7 weeks of lactation (Figure 1) cannot be explained in full by the effect of supplementation only. It was observed that the concentrate intake began to level off from about the 4th week, whereas the difference in milk production increased steadily until the 7th week of lactation, followed by a steady decrease. This is in contrast to the results obtained with milk goats (Morand-Fehr & Sauvant, 1978), in which a positive correlation coefficient of 0,75 and 0,83 was found between energy intake and milk yield during early lactation (0 – 8 weeks) and late lactation (9 – 27 weeks) respectively.

Average milk production per day of the control group (2,05 l) corresponds well with the 1,81 l/d, 2,21 l/d and 1,90l/d reported for mature twin suckled Boer goat ewes by Ueckermann (1969), Raats, *et al.* (1983) and Fourie & Venter (1985) respectively. Ueckermann (1969) and Fourie & Venter (1985) determined milk yield through the 'kid-suckling method'.

The results on milk composition confirm the suggestion that there is a strong tendency in animals to produce milk of a uniform composition under widely varying conditions (Sachdeva, *et al.*, 1974). However, the results from various reports on the effect of level of nutrition on milk composition are contradictory (Morand-Fehr & Sauvant 1978; Sauvant & Morand-Fehr 1978, unpublished, cited by Morand-Fehr, 1981; El-Serafy, *et al.* 1982 and Mittal, 1985).

The average change in live mass of the supplemented ewes compares well with the finding of Rai & Chorey (1965). These workers supplemented Jamnapari goat ewes with 750 g concentrates per day and observed a 15% reduction in live mass during the first 4 weeks of lactation, corresponding to the figure of 16% obtained in this study from the supplemented group.

The failure of supplementation to markedly increase the milk yield of Boer goat ewes, coupled with the effect of vegetation on milk production merits further research into the effect of period of occupation per camp and related factors on the performance of Boer goats on natural veld.

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References

ACOCKS, J.P.H., 1975. Veld types of South Africa. Mem. Bot. Survey. S. Afr. No. 40. Govt. Printer, Pretoria.

AOAC, 1975. Official methods of analysis. 12th Edition. Association of Official Agricultural Chemists. Washington DC.

EL-SERAFY, A.M., REFAAT, I., KHATTAB, H.M., EL-ASHRY, M.A., SOLIMAN, H.S., KOTBY,S. & EL-BADAWY, A., 1982. Production performance of local goats fed on rations with different roughage: concentrate ratios III. Milk production and composition. Agric. Research Review (1980, publ. 1982) 58(b), 137. *Dairy Sci. Abstr.* 1984, 46(6), 3363.

FOURIE, A.J. & VENTER, J.J., 1985. Die melkproduksievermoë van die Veredelde Boerbok in 'n gras-/bosgemeenskap. *S. Afr. J. Anim. Sci.* 15(2), 56.

GALL, C., 1981. Milk production. In: Goat production. Ed. GALL, C. Academic Press. London. p.309.

HARVEY, W.R., 1960. Least-sqaures analysing with unequal subclass numbers. Pamf. U.S. Dep. Agric ARS 20, 8.

IDF, 1962. Int. Stand. FIL-IDF 20. International Dairy Federation. Brussels.

IDF, 1974. Int. Stand. FIL-IDF 28A. International Dairy Federation. Brussels.

McCANCE, I., 1959. The determination of milk yield in the Merino ewe. *Aust. J. Agric. Res.* 10, 839.

McDONALD, P., EDWARDS, R.A. & GREENHALGH, J.F.D., 1973. Animal nutrition. Edinburgh. Oliver & Boyd.

MITTAL, J.P., 1985. Effect of concentrate feeding on yield and composition of milk of Saanen goat. In Proc. of the 3rd AAAP Ani. Sci. Congress. May 6–10, 1985. Vol.2. Seoul, Korea Republic. *Dairy Sci. Abstr.* 1986. 48(12), 6947.

MORAND-FEHR, P., 1981. Nutrition and feeding of goats: Application to temperate climatic conditions. In: Goat production. Ed. Gall, C. Academic Press. London. p.193.

MORAND-FEHR, P. & SAUVANT, D., 1978. Nutrition and optimum performance of dairy goats. *Livestock Prod. Sci.* 5,203.

RAATS, J.G., WILKE, P.I., & DU TOIT, J.E.J., 1983. The effect of age and litter size on milk production in Boer goat ewes. *S. Afr. J. Anim. Sci.* 13(4), 240.

RAI, G.S. & CHOREY, P.A., 1965. Lactational performance of Jamnapari and Barbari goats. *Indian Vet. J.* 42, 958.

SACHDEVA, K.K., SENGAR, O.P.S., SINGH, S.N. & LINDAHL, I.L., 1974. Studies on goats: 2. Effect of plane of nutrition on milk production and composition. *Milchwissenschaft* 29(8), 471.

SAUVANT, D. & MORAND-FEHR, P., 1977. Influence of nutrient levels in concentrates during a full lactation on the performance of goats. In: Symp. Goat Breed. Mediterranean countries, Malaga, Granada, Murcia, Spain. p. 174.

TEAGUE, W.R., TROLLOPE, W.S.W. & AUCAMP, A.J., 1981. Veld management in the semi-arid bush-grass communities of the Eastern Cape. *Proc. Grassld. Soc. S. Afr.* 16, 23.

TEAGUE, W.R., 1987. Defoliation and browse production of *Acacia karroo*, Hayne, in Eastern Cape, South Africa. Ph D thesis, University Witwatersrand.

TROLLOPE, W.S.W., 1981. The growth of shrubs and trees and their reaction to treatment. In: Veld and pasture management in South Africa. 1st Edition. Ed. Tainton, N.M. Shuter & Shooter, Pietermaritzburg. p. 249.

UECKERMANN, L., 1969. Produksie met Boerbokke. M Sc (Agric) thesis, University of Pretoria.

VAN DER MERWE, F.J., 1977. Dierevoeding. Stellenbosch: Kosmo-uitgewery.